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(54) **PROCESS FOR THE PREPARATION OF A CROSSLINKER COMPOSITION**

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PROCÉDÉ DE PRÉPARATION D'UNE COMPOSITION D'AGENT RÉTICULANT

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DescriptionField of the Invention

5 **[0001]** The present invention is directed to a process for the preparation of a crosslinker composition. It is also directed to a coating composition comprising the crosslinker composition prepared by the said process, and to a method of use of the said coating composition to provide a coating on a substrate.

Background of the Invention

10 **[0002]** Industrial coatings are used to protect the surface of a substrate against deterioration brought about by the action of light, humidity, wear, atmospheric oxygen, and other chemicals, and to impart the desired appearance such as colour, gloss, and surface structure. In many cases, such coatings are based on organic polymers which show good adhesion to the substrate and form a film free from defects such as pores or blisters. Film formation, also referred to as drying, is the transition of the coating composition applied to the solid state. The solid film can be formed from a solution by removal of solvent or from a dispersion by removal of the dispersing agent, or from a melt by cooling. In this case, and if no chemical reaction occurs, this is referred to as "physical drying". In the so-called chemical drying, chemical reactions occur during film formation which lead to crosslinked macromolecules. Such crosslinking may be caused by chemical reaction of low molar mass molecules, oligomers or macromolecules between themselves, such as addition or condensation reactions, or radiation induced or thermally induced polymerisation, or by the action of added polyfunctional molecules, the so-called crosslinkers, which react with functional groups of polymers usually referred to as binder resins.

20 **[0003]** A well-known class of crosslinkers used in conjunction with binder resins having active hydrogen-containing reactive groups, such as hydroxyl and carboxyl groups, are the so-called amino resins, adducts of formaldehyde and triazines such as melamine, which are usually at least partially etherified with lower alcohols such as methanol, and n- or iso-butanol. These crosslinkers suffer from the drawback that formaldehyde, inter alia, is liberated during the curing or crosslinking reaction. Emission of formaldehyde is environmentally undesirable. Additionally, these amino resins need temperatures typically of at least 80 °C to act as crosslinkers. Heating to such elevated temperatures is energy-consuming.

25 **[0004]** In WO 97/011 119, formaldehyde-free crosslinkers have been described which are reaction products of 2,2-dialkoxyethanal, an alcohol, and an amino compound having at least two >NH groups, which are selected from the group consisting of amino-1,3,5-triazines, glycolurils, and oligomers thereof. EP 0 381 905 A1 relates to water-soluble amino-plast resins which are derived from urea, N,N'-dimethylurea, ethyleneurea, or 4,5-dihydroxyethylene urea, and a mixture of glyoxal and its monoacetal.

30 **[0005]** It is an object of this invention, therefore, to provide an improved process for the preparation of a crosslinker composition which does not liberate formaldehyde upon curing, and which initiates curing at ambient temperature or only slightly increased temperature, preferably not in excess of 80 °C.

Summary of the Invention

35 **[0006]** This object has been achieved by an improved process for the preparation of a crosslinker composition based on reaction products of cyclic ureas and multifunctional aldehydes having at least two aldehyde groups



45 or, for short, CHO.

50 **[0007]** Such crosslinker compositions have been described in the patent US 4,284,758. Reaction products are described therein which are made by reacting ethylene urea (2-imidazolidinone) with glyoxal, and optionally etherifying the adduct with methanol. While the non-etherified adduct had gelled already after storage for one week, the etherified adduct showed a viscosity increase of about 4.6-fold upon storage for ten weeks at 48 °C. These etherified adducts were used to increase the resistance and stability of textile materials.

55 **[0008]** In the investigations that have led to the present invention, it has been found that coating compositions comprising active hydrogen containing resins, such as hydroxy functional alkyd, acrylic, urethane or epoxy resins can be cured with such crosslinkers even at ambient temperature. However, it was found that the appearance of the resulting coatings was not satisfactory, and the coating showed insufficient stability against solvents, and were prone to yellowing.

[0009] In further experiments conducted, it has been found, surprisingly, that another reaction sequence, i. e. first mixing and at least partially reacting the aldehyde component with an alcohol, and then reacting this mixture with a cyclic urea which may be preformed, or formed in situ, has led to crosslinker compositions that did not exhibit the said disadvantages: these crosslinker compositions do not evolve formaldehyde as they are based on aldehydes different from formaldehyde, they have led to fast cure at ambient temperature as evidenced by the evolution of hardness, and they have led to coatings having high gloss and low yellowing, and good chemical resistance.

[0010] It is an object of the invention to provide an improved crosslinker composition for binder resins having active hydrogen functionality and which not evolve formaldehyde upon curing, which exhibit fast cure at ambient temperature, and which lead to coatings having high gloss and low yellowing, and good chemical resistance.

[0011] It is a further object of the invention to provide a process to make such improved crosslinker composition.

[0012] It is yet another object of the invention to provide a combination of active hydrogen functional binder resins and a crosslinker composition that cures at ambient temperature without evolution of formaldehyde, and that leads to improved properties of the paint film such as higher hardness, better chemical stability, higher gloss and lower yellowness.

[0013] These objects have been achieved by a process for the preparation of a crosslinker composition, comprising the steps of

- providing a mixture of an aliphatic alcohol A having at least one hydroxyl group and from 1 to 10 carbon atoms, with at least one multifunctional aldehyde C having at least two aldehyde groups -CHO to form a mixture AC,
- heating the mixture AC to convert at least a part of the multifunctional aldehyde C to its hemiacetal or to its acetal to form a mixture (AC)',
- adding to the mixture (AC)' at least one cyclic urea U which cyclic urea U is selected from the group consisting of ethylene urea, 1,3-propylene urea, and 1,4-butylene urea and may be substituted by alkyl groups on the C- or N-atoms, or both, or by alkoxy groups on the C-atoms of the ring, and has at least one unsubstituted >NH group, and reacting the mixture thus obtained to form a chemical bond between the nitrogen atom of the at least one unsubstituted >NH group of the at least one cyclic urea U, and the carbon atom of the least one aldehyde group -CHO of the multifunctional aldehyde C, and reacting the reaction product obtained with an aliphatic alcohol A' having one hydroxyl group and from 1 to 10 carbon atoms, whereby at least a part of the hydroxyl groups of the said alcohol A' is converted to ether groups.

[0014] It goes without saying that even by reacting the aldehyde C to its hemiacetal or to its acetal, the carbon atom of the aldehyde group remains the same, therefore it is equivalent to say "the carbon atom of the least one aldehyde group -CHO of the multifunctional aldehyde C", and "the carbon atom of the at least one aldehyde group -CHO of the multifunctional aldehyde C which said aldehyde group is converted to a hemiacetal group or acetal group by reaction with the alcohol A'".

Detailed Description of the Preferred Embodiments

[0015] The aliphatic alcohols A useful for the invention have at least one hydroxyl group, and from one to ten carbon atoms. They can be linear, branched or cyclic, preferably linear or branched, and preferably have from one to eight carbon atoms, such as methanol, ethanol, n- and iso-propanol, and the isomeric butanols, particularly n-butanol, and iso-butanol, n-hexanol, or 2-ethylhexanol. Polyhydric alcohols which may be used, alone or in mixture with monohydric alcohols, include ethylene glycol, 1,2- and 1,3-propane diol, 1,2- and 1,4-butane diol, 1,2- and 1,6-hexane diol, glycerol, trimethylol ethane and trimethylol propane, pentaerythritol, diglycerol, ditrimethylol ethane and ditrimethylol propane, mannitol and sorbitol. It is also possible to employ mixtures of the monohydric alcohols, such as a mixture of methanol and iso-butanol, or mixtures of the said polyhydric alcohols with each other or mixtures thereof with monohydric alcohols.

[0016] The multifunctional aldehydes C have at least two aldehyde groups, and are preferably aliphatic in nature. Preferred aldehydes are glyoxal, succinic dialdehyde, and glutardialdehyde. It is also possible to use mixtures of these.

[0017] The cyclic ureas U which may be used according to the present invention have at least one unsubstituted amidic >NH group. These cyclic ureas U are cycloaliphatic compounds having an element of the structure -NH-CO-NH- within a ring structure, the total number of ring atoms being from 5 to 7 (ethylene urea, 1,3-propylene urea, 1,4-butylene urea or tetramethylene urea). These cyclic ureas may be substituted, preferably by alkyl groups on the N- or C-atoms, or both, or by hydroxy or alkoxy groups on the C-atoms of the ring, the alkyl or alkoxy residues in both cases preferably having from one to four carbon atoms. At least one of the nitrogen atoms must remain unsubstituted to enable reaction with the aldehyde or (hemi)acetal functional molecule. It is also preferred to use mixtures of two or more of the mentioned cyclic ureas. Adducts of these latter mixtures of these with glyoxal which are at least partially etherified have shown particularly good reactivity at ambient temperature. Such mixtures can be prepared by reacting mixtures of the cyclic ureas with glyoxal, or by reacting the cyclic ureas individually with glyoxal, and then mixing the reaction products. Preferably, the at least one cyclic urea U is selected from the group U1 consisting of ethylene urea, and from the group

U2 consisting of the ureas U1 which additionally have at least one substituent R on at least one of the nitrogen or carbon atoms of the said ureas U1, with the proviso that at least one nitrogen atom is unsubstituted, and the substituent R is selected from the group consisting of linear, branched and cyclic alkyl groups having from 1 to 10 carbon atoms.

[0018] In the process according to the invention, in the first step, the multifunctional aldehyde is charged first, and the alcohol is then added in stoichiometric excess. Another way of preparing the mixture of the aldehyde C and the alcohol A is first to charge the alcohol A, then adding the aldehyde C, optionally removing at least a part of the water if the aldehyde is used in the form of an aqueous solution, or first to charge the aldehyde C, optionally removing at least a part of the water if the aldehyde is supplied as an aqueous solution, and then adding the alcohol A. An inert gas blanket may preferably be used, such as nitrogen or argon.

[0019] The mixture thus formed is preferably heated to a temperature of from 40°C to 120°C to remove a part of the alcohol and the water, with preferably not more than 15 % of the water of the aqueous solution being left; preferably, the water is removed to leave preferably at most from 5 % to 10 % of the initial quantity. An inert gas blanket may preferably also be used in this step, such as nitrogen or argon. Application of reduced pressure is favourable to help removing most of the water. During this heating step, at least a part of the aldehyde C is converted to its hemiacetal by addition of alcohol A, or partially to its acetal by addition of one molecule of alcohol A and subsequent condensation with a further molecule of alcohol A with liberation of one molecule of water.

[0020] After cooling the mixture to room temperature, more alcohol A is added, the cyclic urea U is then added, and the pH is adjusted preferably to from 1.0 to 4.0 by addition of acid. Addition of a dialdehyde to the amidic >NH group of the cyclic urea yields a structure of the formula >N-CH(OH)-X where X stands for the dialdehyde where one of the -CHO groups has been removed. The reaction mixture is heated and kept at elevated temperature until the aldehyde groups are consumed and at least a part, preferably at least 40 % of the hydroxyl groups formed by addition of the aldehyde to the amidic >NH group have been converted to ether groups by reaction with the excess alcohol. The remaining excess alcohol is removed by distillation under reduced pressure to the desired degree, yielding a mass fraction of solids of preferably from 55 % to 90 %, particularly preferably from 60 % to 80 %.

[0021] The crosslinker composition solutions thus obtained can be combined both with solvent borne and with water borne binder resins having active hydrogen functionality (hydroxyl or carboxylic acid groups). Although the qualitative composition of an ethylene urea / glyoxal resin prepared according to the invention is similar to that described in the cited US patent 4,284,758, it was found that the crosslinker compositions prepared according to the invention have a higher reactivity and can be used for curing even at room temperature, and that the appearance of the cured films is also favourable for the crosslinkers according to the present invention, in yellowness and gloss and haziness.

[0022] This favourable performance could not have been expected from changing the sequence of reaction steps.

[0023] In further experiments conducted in connection with this invention, it has also been found that addition of boric acid to the crosslinker composition of the present invention can further improve the colour of the said crosslinker composition. This effect is particularly marked if boric acid is added to the mixture AC, comprising an aliphatic alcohol A and at least one multifunctional aldehyde C, or, in the alternative, to the mixture (AC)', i. e. to a mixture that comprises the reaction product of the aldehyde C and of the alcohol A, in the form of the acetal or hemiacetal of the aldehyde C. It is also possible, with good results, to add boric acid in two portions, one portion to the mixture AC, and one portion to the mixture (AC)'. It has been found that the optimum quantity of boric acid, measured as the ratio of the amount of substance n_B of boric acid H_3BO_3 , to the sum n_G of the amounts of substance of glyoxal, of the hemiacetal and of the acetal of glyoxal, is from 0.5 % to 25 %, preferably from 1 % to 20 %, and particularly preferred, from 3 % to 15 %. Combining binder resins with such boric acid-modified crosslinkers leads to coatings having particularly low yellowness index, and good colour retention.

[0024] It has been verified that the crosslinker compositions according to the invention can be combined with solvent borne or water borne resins having hydroxy or carboxylic acid functionality, or both, particularly with hydroxy or carboxylic acid functional alkyd resin, hydroxy or carboxylic acid functional acrylic resins, hydroxy functional polyurethane resins, and hydroxy functional epoxy resins. As these crosslinker compositions are active already at ambient temperature, they are particularly useful to cure coatings on heat sensitive substrates, such as paper, cardboard, textiles, leather, wood, and also plastics. Application of said crosslinker composition in combination with the binder resins mentioned supra can also be considered where cure temperature or energy savings are an issue. Usual additives such as defoamers, adhesion promoters, wetting agents, sag control agents, and pigments can, of course, be used in paint formulations comprising the crosslinker compositions of the present invention.

[0025] The coating compositions can be applied by any of the known techniques such as spraying, dipping, brushing, and using a doctor blade.

[0026] The following examples illustrate the invention, without intending to limit. All concentrations (strengths) and ratios stated in "%" are mass fractions (ratio of the mass m_B of a specific substance B, divided by the mass m of the mixture, in the case of a concentration, or by the mass m_D of the second substance D, in the case of a ratio).

Example 1: Butylated Ethyleneurea-Glyoxal Resin

[0027] A resin according to the invention was prepared by the following procedure: 72.6 g (0.5 mol) of a 40 % strength aqueous solution of glyoxal at room temperature (23 °C) is charged to the reaction vessel under a nitrogen purge followed by 748 g (4.9 mol) of 1-butanol. The mixture was heated to 62 °C, and excess butanol was removed under reduced pressure (210 Torr [28 kPa] ramped to 140 Torr [19 kPa]) while allowing the reaction temperature to rise to a maximum of 72 °C. After 2 hours, approximately one-quarter of the excess butanol had been removed and the mass fraction of water remaining in the reaction mixture was less than 5 %. The reaction solution was then cooled to ambient temperature.

[0028] To the dehydrated glyoxal solution, 148 g (2 mol) of 1-butanol and 48 g (0.5 mol) of ethylene urea hemihydrate were charged. The pH was adjusted to 2.3 with 26 % strength aqueous sulphuric acid, and the reaction temperature was then raised and maintained at from 57 °C to 63 °C for approximately 90 minutes. After 90 minutes, the reaction mixture was then concentrated under reduced pressure (130 Torr [17 kPa]) while heating up to a maximum temperature of 78 °C. The light yellow resin solution (170 g) was then cooled to 30 °C and 38 g of 1-butanol were charged to obtain a final Gardner-Holdt viscosity of **W** and a mass fraction of solids of 66 %. The degree of alkylation and the molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses to be 1.5 mol of alkoxy groups per 1 mol of glyoxal, and 1.86 mol of alkoxy groups per 1 mol of ethylene urea, and 4500 g/mol, respectively.

Example 2 (Comparative) : Example 4 of Sun Chemical US Patent 4284758, butanol

[0029] 290 g (2 mol) of a 40 % aqueous glyoxal solution were charged to a 1L reactor and the pH was adjusted to 6.4 with 0.69 g (0.008 mol) of solid sodium bicarbonate. 176 g (2 mol) of ethyleneurea were added, the pH was adjusted to 6.5 by addition of 25 % strength aqueous sulphuric acid, and the reaction temperature was raised to (55 ± 5) °C. After 2 hours, the reaction mixture was cooled to 38 °C, and 462 g (6.23 mol) of 1-butanol were added. The pH of the mixture was adjusted to about 3.0 by adding 0.65 g (0.0066 mol) of concentrated sulphuric acid. The reaction temperature was then raised and held at reflux for 3 hours to effect butylation. Upon cooling to 30 °C, the pH of the resin solution was adjusted to about 7.0 by adding 2.0 g of a 25 % strength aqueous solution of caustic soda.

[0030] The product was a dark yellow emulsion (about 900 g) having a Gardner-Holdt viscosity of F and a mass fraction of solids of about 40 %. The degree of alkylation and the molar mass of the crosslinker product were determined as supra. The following results were obtained:

1.22 mol of alkoxy groups per 1 mol of glyoxal, and 0.95 mol of alkoxy groups per 1 mol of ethylene urea, and 4300 g/mol, respectively.

Example 3: Ethylated Ethyleneurea-Glyoxal Resin

[0031] A resin according to the invention is prepared by the following alternative procedures:

3a. Dehydration of aqueous aldehyde solution via strip and addition of ethanol

[0032] 559 g (3.85 mol) of a 40 % strength aqueous solution of glyoxal at room temperature was charged to a 5 L reaction vessel followed by 2355 g (51.1 mol, 2.9 L) of anhydrous ethanol. The mixture was heated to from 45 °C to 50 °C, and water together with excess ethanol were removed under reduced pressure (250 Torr [33 kPa] ramped to 150 Torr [20 kPa]). After two hours, approximately 72 % of the excess ethanol had been removed and the mass fraction of water remaining in the reaction mixture was 13.5 %. A second charge of anhydrous ethanol (1577 g, 34.2 mol) was added to the reactor and the distillation was continued at 46 °C under reduced pressure (135 Torr [18 kPa] to 125 Torr [17 kPa]) for an hour. Approximately 86 % of the charged ethanol had been removed and the mass fraction of water remaining in the reaction mixture was less than 5 %. The reaction solution was then cooled to ambient temperature.

[0033] To this dehydrated glyoxal solution, 900 g (19.5 mol) of anhydrous ethanol and 342.6 g (3.98 mol) of ethylene urea were charged. Final reaction mixture pH after additions was 3.85. The reaction mixture was then heated to from 45 °C to 48 °C and held for two hours. After two hours, the pH of the reaction mixture was adjusted to 2.9 by adding 25 % strength aqueous sulphuric acid, and heating was then continued at from 49 °C to 53 °C for three additional hours. By adding 25% aqueous sodium hydroxide solution, pH was then adjusted to 4.6, and the reaction mixture was concentrated under reduced pressure (150 Torr [20 kPa] ramped to 23 Torr [3 kPa]) and at a temperatures of from 41 °C to 50 °C. The light yellow resin solution (730 g) was then cooled to ambient temperature and 144 g of anhydrous ethanol were charged to obtain a final Gardner-Holdt viscosity of **U** and a mass fraction of solids of 63 %. Degree of alkylation and molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses as 1.44 mol of alkoxy groups per 1 mol of glyoxal, and 1.11 mol of alkoxy groups per 1 mol of ethylene urea, and 4100 g/mol, respectively. Hazen APHA colour value of the crosslinker product determined in accordance with DIN ISO 6271 was 115.

3b. Dehydration of aqueous aldehyde solution via glyoxal concentration

[0034] 947 g (6.5 mol) of 40 % strength aqueous solution of glyoxal were charged to a reaction vessel under a nitrogen purge, heated to from 61 °C to 66 °C and then concentrated under reduced pressure (23 Torr [3.1 kPa]). After eighty minutes, approximately 413 g of water had been removed to yield an aqueous glyoxal solution of approximately 71 % strength as a viscous oil. This dehydrated glyoxal solution was then cooled to ambient temperature, 2400 g (52.1 mol) of anhydrous ethanol were charged, pH was adjusted to 3.3 with 26 % strength aqueous sulphuric acid, and the resulting mixture was heated to from 61 °C to 70 °C for two and one half hours followed by cooling to ambient conditions. The mass fraction of water was approximately 5 %. To this dehydrated ethanolic glyoxal solution, 572 g (6.6 mol) of ethylene urea were charged, and the reaction mixture was kept at (55 ± 5) °C for three hours. The reaction mixture was then cooled to 40 °C, pH was adjusted to 2.8 to 3.0 with 26 % strength aqueous sulphuric acid and the reaction temperature was then again raised to (55 ± 5) °C and maintained for approximately four hours. The reaction mixture was then cooled to 30 °C, pH was adjusted to 3.3 to 3.7 by addition of sodium hydroxide solution, reheated to from 45° to 50 °C, and then concentrated under reduced pressure (280 Torr [37 kPa] ramped to 155 Torr [20.7 kPa]) for four hours. The resulting light yellow resin solution (approximately 1.6 kg) having a Gardner-Holdt viscosity of G- was cooled to ambient conditions. The mass fraction of solids of the resin solution was approximately 62 %. Degree of alkylation and molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses as 1.44 mol of alkoxy groups per 1 mol of glyoxal, and 1.14 mol of alkoxy groups per 1 mol of ethylene urea, and 3850 g/mol, respectively. Hazen APHA colour value of the crosslinker product determined in accordance with DIN ISO 6271 was 117.

Example 4 (Comparative): Example 4 of Sun Chemical US Patent 4,284,758, ethanol

[0035] 290 g (2 mol) of a 40 % strength aqueous glyoxal solution were charged to a 1L reactor and the pH was adjusted to 6.3 with 1.1 g (0.013 mol) of solid sodium bicarbonate. 176 g (2 mol) of ethyleneurea were added, the pH was adjusted to 6.4 with 25 % strength aqueous sulphuric acid, and the reaction temperature was raised to (55 ± 5) °C. After 2 hours the reaction mixture was cooled to 40 °C, and 288 g (6.25 mol) of ethanol were added. pH of the mixture was adjusted to about 3.0 with 1.0 g (0.010 mol) of concentrated sulphuric acid. The reaction temperature was then raised and held at reflux for 3 hours to effect ethylation. Upon cooling to from 29 °C to 30 °C, the pH of the resin solution was adjusted to about 7.1 with 3.2 g (0.20 mol) of a 25 % strength aqueous solution of sodium hydroxide.

[0036] The product was a dark yellow solution (approximately 745 g) having a Gardner-Holdt viscosity of A-B and a mass fraction of solids of approximately 45 %. Degree of alkylation and molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses as 1.13 mol of alkoxy groups per 1 mol of glyoxal, and 1.00 mol of alkoxy groups per 1 mol of ethylene urea, and 1840 g/mol, respectively. Hazen APHA colour value of the crosslinker product determined in accordance with DIN ISO 6271 was 468.

Example 5: Comparative Cure Results

[0037] A master resin batch was prepared which was composed of 116.7 g of a short oil alkyd based on cocoanut oil (BECKOSOL® 12035, Reichhold Inc.), 20 g (0.27 mol) of 1-butanol, and 10 g of a mixture of toluene sulphonic acids dissolved in isopropanol (acid number of solution 135 mg/g; CYCAT® 4040 Catalyst, Cytec Industries Inc.). To portions of this master batch were then added the crosslinkers from Examples 1-4 in the amounts as stated in Table I infra, along with additional 1-butanol to provide a coating formulation with a mass fraction of solids of 45 % and an overall mass ratio of binder to crosslinker of 70/30.

Table 1

Crosslinker from Example	mass of crosslinker in g	mass of resin master batch in g	mass of butanol in g
1	3.11	10	2.09
2	5.26	10	-0.06
3	3.31	10	1.89
4	4.56	10	0.64

[0038] The formulations were drawn down on phosphated ®Bonderite 1000 cold rolled steel (CRS) panels, white-base coated steel panels and wood using a #52 wire-coater bar and were allowed to cure at ambient temperature.

[0039] The print resistance and pendulum hardness values of the resulting films on CRS panels were measured after

2 and 24 hrs and are tabulated in the following table 2:

Table 2

Crosslinker of Example	1	2	3	4
Film Appearance	good	low gloss	good	low gloss
Gloss 20° / 60°	---	---	87 / 94	12/44
2 h; print resistance	0 .. 1	1 .. 2	0 .. 1	3 .. 4
2 h; pendulum hardness	42	19	46	28
24 h; pendulum hardness	127	38	123	56
24 hr MEK rubs	55	35	45	<35

[0040] Film appearance was rated "good" if there were no defects visible to the naked eye; "low gloss" means a hazy appearance. Print resistance was determined in accordance with ASTM D 2091-96 (2003) "Standard Test Method for Print Resistance of Lacquers", a rating of "0" is "no mar", and a rating of "5" is "very marred". A rating of "1 .. 2" stands for "between 1 and 2". "Pendulum" is the test according to König (ASTM D4366-95, EN ISO 1522 or DIN 53157) where oscillation damping is used as indicator for surface hardness, measured in seconds, after the specified drying time. Degree of crosslinking is judged by the number of double rubs with a pad soaked with methyl ethyl ketone (MEK) without impairment of the paint film.

[0041] From this data it is evident that the products of this invention (Examples 1 and 3) provide superior performance relative to the Sun Chemical patent derived products (Examples 2 and 4) in the areas of coating appearance (gloss), print resistance, pendulum hardness and degree of crosslinking.

Example 6: Comparative Cure Results with an Aged Formulation

[0042] Formulations prepared with 6 day aged master batch detailed in Example 5 using the crosslinkers of Examples 1 and 2 were drawn down on Bonderite 1000 CRS panels and on glass plates and were allowed to cure under ambient conditions.

[0043] The pendulum hardness values and MEK resistance of the resulting films on CRS panels were measured after 2 and 24 hrs and are tabulated in the following table 3:

Table 3

Crosslinker of Example	1	2
Film Appearance	Slight haze	Very Hazy
Gloss 20° / 60°	95 / 98	2/10
2 h; pendulum hardness	42	19
24 h; pendulum hardness	163	141
24 h; MEK rubs	at 200 : 20 % removed	at 47: fail
Yellow Index, YI	3.45	3.91

[0044] From these data it is evident that the combination of binder resin and crosslinker according to this invention (Crosslinker of Example 1) provided superior performance relative to the Sun Chemical patent derived product (Crosslinker of Example 2) in the areas of coating appearance (haziness and gloss), print resistance, pendulum hardness after 2 and 24 hours of cure, and degree of crosslinking as judged by the number of double rubs with a pad soaked with MEK rub resistance. With the crosslinker of Example 1, approximately 20 % of the area covered with the coating was blank after 200 double rubs, i. e. the coating was removed.

[0045] As can be seen from the comparison, paint films formed with the crosslinker composition according to the invention have a better surface (gloss, haziness, colour) compared to the state of the art, and the curing speed at ambient temperature is far higher, as evidenced by the development of hardness, and the degree of crosslinking is markedly better even after aging.

Example 10: Ethylated Ethyleneurea-Glyoxal Resin

A resin according to the invention was prepared by the following procedure

- 5 **[0046]** (Dehydration of aqueous aldehyde solution via strip and addition of ethanol):
[0047] 559 g (3.85 mol) of a 40 % strength aqueous solution of glyoxal at room temperature were charged to a 5 L reaction vessel followed by 2355 g (51.1 mol, 2.9 L) of anhydrous ethanol. The mixture was heated to from 45 °C to 50 °C, and water together with excess ethanol were removed under reduced pressure (250 Torr [33 kPa] ramped to 150 Torr [20 kPa]). After two hours, approximately 72 % of the excess ethanol had been removed and the mass fraction of water remaining in the reaction mixture was 13.5 %. A second charge of anhydrous ethanol (1577 g, 34.2 mol) was added to the reactor and the distillation was continued at 46 °C under reduced pressure (135 Torr [18 kPa] to 125 Torr [17 kPa]) for an hour. Approximately 86 % of the charged ethanol had been removed and the mass fraction of water remaining in the reaction mixture was less than 5 %. The reaction solution was then cooled to ambient temperature.
 10 **[0048]** To 93.5 g (0.5 mol) of this dehydrated glyoxal solution, 138 g (3.0 mol) of anhydrous ethanol and 43.0 g (0.50 mol) of ethylene urea were charged. Final reaction mixture pH after additions was 3.68, which was then adjusted to 2.88 by addition of nitric acid of 70 % strength. The reaction mixture was then heated to a range of from 55 °C to 59 °C and held for two hours. The light yellow resin solution (202 g) was then cooled to ambient temperature and having a mass fraction of solids of 39 %. Degree of alkylation and molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses as 1.31 mol of alkoxy groups per 1 mol of glyoxal, and 1.22 mol of alkoxy groups per 1 mol of ethylene urea, and 2350 g/mol, respectively. Hazen APHA colour value (DIN-ISO 6271) of the crosslinker product was measured as 27. Sodium ion content by ICP-AES was approximately 7 mg/kg.
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Example 11 (Comparative): Example 4 of Sun Chemical US Patent 4,284,758, ethanol

- 25 **[0049]** 290 g (2 mol) of a 40 % strength aqueous glyoxal solution were charged to a reactor having a volume of 1 L, and the pH was adjusted to 6.2 by addition of 0.7 g (0.009 mol) of solid sodium bicarbonate. 176 g (2 mol) of ethyleneurea were added, the pH was adjusted to 6.6 by addition of 25 % strength aqueous sulphuric acid, and the reaction temperature was raised to (55 ± 5) °C. After two hours, the reaction mixture was cooled to 40 °C, and 288 g (6.25 mol) of anhydrous ethanol were added. pH of the mixture was adjusted to about 3.0 by addition of 0.9 g (0.009 mol) of concentrated sulphuric acid.
 30 acid. The reaction temperature was then raised and held at reflux for three hours to effect ethylation. Upon cooling to 29 °C to 30 °C, the pH of the resin solution was adjusted to about 7.0 by addition of 2.6 g (0.016 mol) of a 25 % strength aqueous solution of sodium hydroxide.
[0050] The product was a deep yellow solution (approximately 742 g) having a Gardner-Holdt viscosity of A-, and a mass fraction of solids of approximately 48 %. Degree of alkylation and molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses as 1.20 mol of alkoxy groups per 1 mol of glyoxal, and 1.02 mol of alkoxy groups per 1 mol of ethylene urea, and 2520 g/mol, respectively. Hazen APHA colour value (DIN-ISO 6271) of the crosslinker product was measured as 548. Sodium ion content by ICP-AES was 460 mg/kg.
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Example 13 (Comparative): Sun Chemical US Patent 4,284,758, with ethanol

- 40 **[0051]** 290 g (2 mol) of a 40 % strength aqueous glyoxal solution were charged to a 1L reactor and the pH was adjusted to 6.5 by addition of 0.7 g (0.009 mol) of solid sodium bicarbonate. 60 g (1 mol) of urea were added, the pH was adjusted to 6.6 by addition of 25 % strength aqueous sulphuric acid, and the reaction temperature was raised to (55 ± 5) °C. After two hours, the reaction mixture was cooled to 40 °C, and 288 g (6.25 mol) of anhydrous ethanol were added. pH of the mixture was adjusted to about 3.0 by addition of 0.53 g (0.005 mol) of concentrated sulphuric acid. The reaction temperature was then raised and held at reflux for three hours to effect ethylation. Upon cooling to 29 °C to 30 °C, the pH of the resin solution was adjusted to 7.03 by addition of 1.9 g (0.012 mol) of a 25 % strength aqueous solution of sodium hydroxide.
 45 **[0052]** The product was a deep yellow solution having a Gardner-Holdt viscosity of A-3 and a mass fraction of solids of approximately 35 %. Degree of alkylation and molar mass of the crosslinker product were determined by C-13 NMR and by HPSEC analyses as 1.69 mol of alkoxy groups per 1 mol of glyoxal, and 1.27 mol of alkoxy groups per 1 mol of 4,5-dihydroxyethylene urea, and 300 g/mol, respectively. Hazen APHA colour value (DIN-ISO 6271) of the crosslinker product was measured as 298. Sodium ion content by ICP-AES was 560 mg/kg.
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Example 14: Comparative Cure Results at 2 % Catalyst Loading

- 55 **[0053]** To individual water-borne resin batches composed of 10.2 g of an aqueous hydroxyl functional acrylic emulsion (Roshield™ 1024 hydroxy functional acrylic emulsion, mass fraction of solids 50 %, Rohm & Haas Co.), 0.2 g of a rheology

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modifier (Acrysol™ RM-12W, combination of polyurethane resin and enzymatically modified starch, mass fraction of solids 19 %, Rohm & Haas Co.) and 0.37 g of a mixture of toluene sulphonic acids dissolved in isopropanol (mass fraction of solids: 40 %, acid number of solution: 135 mg/g; CYCAT® 4040, Catalyst, Cytec Industries Inc.) were then added the crosslinkers from Examples 9 to 11 in the amounts as stated in table 6 infra, along with additional methanol and water to provide coating formulations with a mass fraction of solids of 43.6 % and an overall mass ratio of binder to crosslinker of 70/30. "Catalyst Loading" in this context means ratio of mass of catalyst to mass of total resin solids of the formulation.

Table 6

Crosslinker of Example	mass of crosslinker in g	mass of resin master batch ing	mass of methanol in g	Mass of water in g
9	5.6	10.77	0.3	0.6
10	4.6	10.77	0.2	1.7
11	4.0	10.77	0.3	2.2

[0054] The formulations were drawn down on white-base coated cold rolled steel (WBC-CRS) panels (4 inch x 12 inch, ACT Lab, Inc.), glass panels, and wood using a #52 wire-coater bar and were cured at ambient temperature and baked conditions (fifteen minutes flash / ten minutes at 60 °C / cool for five minutes).

[0055] The MEK resistance, pendulum hardness values, and Yellowness Index (YI) of the resulting films on CRS (cold rolled steel) panels and glass were measured after one hour and after twenty-four hours, and are tabulated in the following table 7 (ethyleneurea-glyoxal resin):

Table 7

Crosslinker of Example	10	11	10	11
Cure conditions	Ambient	Ambient	10 min / 60 °C	10 min / 60 °C
1 h; pendulum hardness	93 s	68 s	114 s	91 s
1 h; MEK rubs	200	30	60	<50
24 h; pendulum hardness	105 s	83 s	106 s	61 s
24 h; YI	-1.1	-0.6	-1.0	-0.6
12 d; Water spot resistance (1h)	Slight haze 8MD	Strong Haze 6D	Very Slight Haze 8MD	Strong Haze 6D

Table 8

Crosslinker of Example	13	13
Cure conditions	Ambient	10 min / 60 °C
1 h; pendulum hardness	n. d.	21 s
1 h; MEK rubs	30	< 50
24 h; pendulum hardness	35 s	n. d.

[0056] "Pendulum" is the test according to König (ASTM D4366-95, EN ISO 1522 or DIN 53157) where oscillation damping is used as indicator for surface hardness, measured in seconds, after the specified drying time. "n. d." stands for "not determined". Degree of crosslinking is judged by the number of double rubs with a pad soaked with methyl ethyl ketone (MEK) without impairment of the paint film. Yellowness Index (YI) is a number calculated from spectrophotometric data (ASTM E313) that describes the change in colour of a test sample from clear or white toward yellow. Water spot resistance is the test according to ASTM D 1308-02 "Standard Test Methods for Effect of Household Chemicals on Clear and Pigmented Organic Finishes" involving placement of drop of water on the film which is covered for a specific length of time and the degree of blistering, swelling, softness or haziness is then assessed. For blistering in accordance with ASTM D714 - 02e1 "Standard Test Method for Evaluating Degree of Blistering of Paints" a rating scale was used where 2 = large blisters and 10 = no blisters and density of blistering is indicated by F = few, M = medium, MD = medium dense,

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and D = dense.

[0057] From the data in tables 7 and 8 it is evident that the products of this invention (Example 10) provide equivalent or superior performance relative to the Sun Chemical patent derived products (Examples 11 and 13) in the areas of pendulum hardness, yellowness index, water spot resistance and degree of crosslinking.

Example 15: Comparative Cure Results at 4 % Catalyst Loading

[0058] To individual water-based resin batches composed of 10.2 g of an aqueous hydroxyl functional acrylic emulsion (Roshield™ 1024 emulsion, Rohm & Haas Co.) and 0.73 g of a mixture of toluene sulphonic acids dissolved in isopropanol (mass fraction of solids: 40 %, acid number of solution: 135 mg/g; CYCAT® 4040, Catalyst, Cytec Industries Inc.) were then added the crosslinkers from Examples 9 to 12 in the amounts as stated in table 9 infra, along with additional methanol and water to provide coating formulations with a mass fraction of solids of 43.6 % and an overall mass ratio of binder to crosslinker of 70/30.

Table 9

Crosslinker from Example	mass of crosslinker in g	mass of resin master batch in g	mass of methanol in g	mass of water in g
9	5.6	10.73	0.3	0.6
10	4.6	10.73	0.2	1.7
11	4.0	10.73	0.3	2.2

[0059] The formulations were drawn down on white-base coated cold rolled steel (WBC-CRS) panels (4 inch × 12 inch, ACT Lab, Inc.) glass panels and wood using a #52 wire-coater bar and were cured at ambient temperature and baked conditions (fifteen minutes flash / ten minutes at 60 °C / cool for five minutes).

[0060] The MEK resistance, pendulum hardness values, and Yellowness Index (YI) of the resulting films on CRS panels and glass were measured after one hour, after twenty-four hours and after forty-eight hours and are tabulated in the following table 10 (ethyleneurea-glyoxal resin) and table 11 (4,5-dihydroxyethylene urea-glyoxal resin):

Table 10

Crosslinker of Example	10	11	10	11
Cure conditions	Ambient	Ambient	10 min / 60°C	10min/60°C
1 h; pendulum hardness	97 s	97 s	n. d.	n. d.
24 h; pendulum hardness	115s	71 s	n. d.	n. d.
48h;YI	-1.1	-0.6	-0.5	-0.2
Water spot resistance, 1 h	n. d.	n. d.	8M	4MD

Table 11

Crosslinker of Example	13	13
Cure conditions	Ambient	10 min/60°C
1 h; MEK rubs	30	n. d.
24 h; MEK rubs	35	n. d.
48h;YI	25.5	67.5
Water spot resistance, 1 h	n. d.	Slight haze

[0061] Water spot resistance is the test according to ASTM D 1308-02 "Standard Test Methods for Effect of Household Chemicals on Clear and Pigmented Organic Finishes" involving placement of drop of water on the film which is covered for a specific length of time and the degree of blistering, swelling, softness or haziness is then assessed. For blistering in accordance with ASTM D714 - 02e1 "Standard Test Method for Evaluating Degree of Blistering of Paints" a rating

scale was used where 2 = large blisters and 10 = no blisters and density of blistering is indicated by F = few, M = medium, MD = medium dense, and D = dense.

[0062] From the data in Tables 10 and 11 it is evident that the products of this invention (crosslinker of Example 10) provide equivalent or superior performance relative to the Sun Chemical patent derived products (crosslinkers of Examples 11 and 13) in the areas of pendulum hardness, Yellowness index, water spot resistance, and degree of crosslinking.

Claims

1. A process for the preparation of a crosslinker composition, comprising the steps of
 - providing a mixture of an aliphatic alcohol A having at least one hydroxyl group and from 1 to 10 carbon atoms, with at least one multifunctional aldehyde C having at least two aldehyde groups -CHO to form a mixture AC,
 - heating the mixture AC to convert at least a part of the multifunctional aldehyde C to its hemiacetal or to its acetal to form a mixture (AC)',
 - adding to the mixture (AC)' at least one cyclic urea U which cyclic urea U is selected from the group consisting of ethylene urea, 1,3-propylene urea, and 1,4-butylene urea and may be substituted by alkyl groups on the C- or N-atoms, or both, or by alkoxy groups on the C-atoms of the ring, and has at least one unsubstituted >NH group, and reacting the mixture thus obtained to form a chemical bond between the nitrogen atom of the at least one unsubstituted >NH group of the at least one cyclic urea U, and the carbon atom of the least one aldehyde group -CHO of the multifunctional aldehyde C, and reacting the reaction product obtained with an aliphatic alcohol A' having one hydroxyl group and from 1 to 10 carbon atoms, whereby at least a part of the hydroxyl groups of the said alcohol A' is converted to ether groups.
2. The process of claim 1, wherein the at least one cyclic urea U is a cycloaliphatic compound selected from the group consisting of ethylene urea and 1,3-propylene urea.
3. The process of claim 1, wherein the at least one cyclic urea U is selected from the group U1 consisting of ethylene urea, and from the group U2 consisting of the ureas U1 which additionally have at least one substituent R on at least one of the nitrogen or carbon atoms of the said ureas U1, with the proviso that at least one nitrogen atom is unsubstituted, and the substituent R is selected from the group consisting of linear, branched and cyclic alkyl groups having from 1 to 10 carbon atoms.
4. The process of claim 1, wherein a mixture of two or more cyclic ureas is used.
5. The process of claim 1, wherein ethylene urea is used as the at last one cyclic urea U.
6. The process of claim 1, wherein glyoxal is used as multifunctional aldehyde C.
7. The process of claim 1 wherein boric acid is added to the mixture AC, or to the mixture (AC)' or to both mixtures AC and (AC)'.
8. A coating composition comprising a binder resin B which has functional groups selected from the group consisting of hydroxyl groups and carboxylic acid groups, the solvent-borne or water-borne binder resin being selected from the group consisting of hydroxy functional alkyd resins, carboxylic acid functional alkyd resins, hydroxy functional acrylic resins, carboxylic acid functional acrylic resins, hydroxy functional polyurethane resins, and hydroxy functional epoxy resins, and a crosslinking composition prepared by the process of claim 1.
9. A coating composition comprising a binder resin B which has functional groups selected from the group consisting of hydroxyl groups and carboxylic acid groups, the solvent-borne or water-borne binder resin being selected from the group consisting of hydroxy functional alkyd resins, carboxylic acid functional alkyd resins, hydroxy functional acrylic resins, carboxylic acid functional acrylic resins, hydroxy functional polyurethane resins, and hydroxy functional epoxy resins, and a crosslinking composition prepared by the process of claim 2.
10. The coating composition of claim 8 wherein the binder resin B is selected from the group consisting of hydroxyfunctional alkyd resins, hydroxyfunctional acrylic resins, hydroxyfunctional polyurethane resins, and hydroxyfunctional

epoxy resins, as well as mixtures thereof.

11. The coating composition of claim 8 wherein the binder resin B is present in the form of an aqueous dispersion.
- 5 12. A method of use of the coating composition of claim 8 comprising mixing a binder resin B which has functional groups selected from the group consisting of hydroxyl groups and carboxylic acid groups, with a crosslinking composition prepared by the process of claim 1, adding thereto a catalyst selected from the group consisting of organic sulphonic acids, organic phosphonic acids, and Lewis acids, applying the mixture thus prepared to a substrate by spraying, brushing, dipping, or with a doctor blade, and optionally, heating to accelerate the curing reaction.
- 10 13. The method of claim 12 wherein the coating composition and catalyst are applied to a substrate selected from the group consisting of paper, cardboard, textiles, leather, wood, plastics, and metals.

15 **Patentansprüche**

1. Verfahren zur Herstellung einer Vernetzerzusammensetzung, bei dem man

20 - eine Mischung eines aliphatischen Alkohols A mit mindestens einer Hydroxylgruppe und 1 bis 10 Kohlenstoffatomen mit mindestens einem multifunktionellen Aldehyd C mit mindestens zwei Aldehydgruppen -CHO bereitstellt, was eine Mischung AC ergibt,
 - die Mischung AC zur Umwandlung mindestens eines Teils des multifunktionellen Aldehyds C in sein Hemiacetal oder sein Acetal erhitzt, was eine Mischung (AC)' ergibt,
 - die Mischung (AC)' mit mindestens einem cyclischen Harnstoff U versetzt, wobei der cyclische Harnstoff U aus der Gruppe bestehend aus Ethylenharnstoff, 1,3-Propylenharnstoff und 1,4-Butylenharnstoff ausgewählt ist und an den C- und/oder N-Atomen durch Alkylgruppen oder an den C-Atomen des Rings durch Alkoxygruppen substituiert sein kann und mindestens eine unsubstituierte >NH-Gruppe aufweist, und die so erhaltene Mischung zur Bildung einer chemischen Bindung zwischen dem Stickstoffatom der mindestens einen unsubstituierten >NH-Gruppe des mindestens einen cyclischen Harnstoffs U und dem Kohlenstoffatom der mindestens einen Aldehydgruppe -CHO des multifunktionellen Aldehyds C umsetzt und das erhaltene Umsetzungsprodukt mit einem aliphatischen Alkohol A' mit einer Hydroxylgruppe und 1 bis 10 Kohlenstoffatomen umsetzt, wodurch mindestens ein Teil der Hydroxylgruppen des Alkohols A' in Ethergruppen umgewandelt wird.

2. Verfahren nach Anspruch 1, bei dem es sich bei dem mindestens einen cyclischen Harnstoff U um eine cycloaliphatische Verbindung aus der Gruppe bestehend aus Ethylenharnstoff und 1,3-propylenharnstoff handelt.

3. Verfahren nach Anspruch 1, bei dem der mindestens eine cyclische Harnstoff U aus der Gruppe U1 bestehend aus Ethylenharnstoff und aus der Gruppe U2 bestehend aus den Harnstoffen U1, die zusätzlich mindestens einen Substituenten R an mindestens einem der Stickstoff- und Kohlenstoffatome der Harnstoffe U1 aufweisen, mit der Maßgabe, dass mindestens ein Stickstoffatom unsubstituiert ist, ausgewählt ist und der Substituent R aus der Gruppe bestehend aus linearen, verzweigten und cyclischen Alkylgruppen mit 1 bis 10 Kohlenstoffatomen ausgewählt ist.

4. Verfahren nach Anspruch 1, bei dem man eine Mischung von zwei oder mehr cyclischen Harnstoffen verwendet.

5. Verfahren nach Anspruch 1, bei dem man als den mindestens einen cyclischen Harnstoff U Methylenharnstoff verwendet.

6. Verfahren nach Anspruch 1, bei dem man als multifunktionellen Aldehyd C Glyoxal verwendet.

7. Verfahren nach Anspruch 1, bei dem man die Mischung AC oder die Mischung (AC)' oder beide Mischungen AC und Mischung (AC)' mit Borsäure versetzt.

8. Beschichtungszusammensetzung, umfassend ein Bindemittelharz B, das funktionelle Gruppen aus der Gruppe bestehend aus Hydroxylgruppen und Carbonsäuregruppen aufweist, wobei das lösungsmittelhaltige oder wässrige Bindemittelharz aus der Gruppe bestehend aus hydroxyfunktionellen Alkydharzen, carbonsäurefunktionellen Alkydharzen, hydroxyfunktionellen Acrylharzen, carbonsäurefunktionellen Acrylharzen, tionellen Polyurethanharzen und hydroxyfunktionellen Epoxidharzen ausgewählt ist, und eine gemäß dem Verfahren nach Anspruch 1 hergestellte

Vernetzungszusammensetzung.

- 5 9. Beschichtungszusammensetzung, umfassend ein Bindemittelharz B, das funktionelle Gruppen aus der Gruppe bestehend aus Hydroxylgruppen und Carbonsäuregruppen aufweist, wobei das ösungsmittelhaltige oder wässrige Bindemittelharz aus der Gruppe bestehend aus hydroxyfunktionellen Alkydharzen, carbonsäurefunktionellen Alkydharzen, hydroxyfunktionellen Acrylharzen, carbonsäurefunktionellen Acrylharzen, hydroxyfunktionellen Polyurethanharzen und hydroxyfunktionellen Epoxydharzen ausgewählt ist, und eine gemäß dem Verfahren nach Anspruch 2 hergestellte Vernetzungszusammensetzung.
- 10 10. Beschichtungszusammensetzung nach Anspruch 8, wobei das Bindemittelharz B aus der Gruppe bestehend aus hydroxyfunktionellen Alkydharzen, hydroxyfunktionellen Acrylharzen, hydroxyfunktionellen Polyurethanharzen und hydroxyfunktionellen Epoxidharzen sowie Mischungen davon ausgewählt ist.
- 15 11. Beschichtungszusammensetzung nach Anspruch 8, wobei das Bindemittelharz B in Form einer wässrigen Dispersion vorliegt.
- 20 12. Methode zur Verwendung der Beschichtungszusammensetzung nach Anspruch 8, bei der man ein Bindemittelharz B, das funktionelle Gruppen aus der Gruppe bestehend aus Hydroxylgruppen und Carbonsäuregruppen aufweist, mit einer gemäß dem Verfahren nach Anspruch 1 hergestellten Vernetzungszusammensetzung mischt, dazu einen Katalysator aus der Gruppe bestehend aus organischen Sulfonsäuren, organischen Phosphonsäuren und Lewis-Säuren gibt, die so hergestellte Mischung durch Spritzen, Streichen, Tauchen oder mit einer Rakel auf ein Substrat aufbringt und gegebenenfalls zur Beschleunigung der Härtungsreaktion erhitzt.
- 25 13. Methode nach Anspruch 12, bei der man die Beschichtungszusammensetzung und den Katalysator auf ein Substrat aus der Gruppe bestehend aus Papier, Pappe, Textilien, Leder, Holz, Kunststoffen und Metallen aufbringt.

Revendications

- 30 1. Procédé de préparation d'une composition d'agent de réticulation, comprenant les étapes pour
- fournit un mélange d'un alcool aliphatique A ayant au moins un groupe hydroxyle et de 1 à 10 atomes de carbone, avec au moins un aldéhyde multifonctionnel C ayant au moins deux groupes aldéhyde -CHO pour former une mélange AC,
 - 35 - chauffer le mélange AC pour convertit au moins une partie de aldéhyde multifonctionnel C en son hémi-acétal ou en son acétal pour former un mélange (AC)',
 - ajouter au mélange (AC)' au moins une urée cyclique U, laquelle urée cyclique U est choisie dans le groupe constitué par l'éthylène urée, la 1,3-propylène urée et la 1,4-butylène urée et peut être substituée par groupes alkyle sur les atomes C ou N, ou les deux, ou par des groupes alcoxy sur les atomes C du cycle, et a au moins
 - 40 un groupe >NH non substitué, et faire réagir le mélange ainsi obtenu pour former une liaison chimique entre l'atome d'azote du au moins un groupe >NH non substitué de la au moins une urée cyclique U, et l'atome de carbone du au moins un groupe aldéhyde -CHO de l'aldéhyde multifonctionnel C, et faire réagir le produit de réaction obtenu avec un alcool aliphatique A' ayant un groupe hydroxyle et de 1 à 10 atomes de carbone, pour lequel au moins une partie des groupes hydroxyle dudit alcool A' est convertie en groupes ether.
 - 45
2. Procédé selon la revendication 1, dans lequel la au moins une urée cyclique U est une composé cycloaliphatique choisi dans le groupe constitué par l'éthylène urée et la 1,3-propylène urée.
3. Procédé selon la revendication 1, dans lequel la au moins une urée cyclique U est choisie dans le groupe U1 constitué par méthylène urée, et dans le groupe U2 constitué par les urées U1 qui comportent en outre au moins une substituant R sur au moins l'un des atomes d'azote ou de carbone desdites urées U1, à condition qu'au moins un atome d'azote soit non substitué, et le substituant R est choisi dans le groupe constitué par les groupes alkyle linéaires, ramifiés et cycliques comportant de 1 à 10 atomes de carbone.
- 50
4. Procédé selon la revendication 1, dans lequel un mélange de deux urées cycliques ou plus est utilisé.
- 55 5. Procédé selon la revendication 1, dans lequel de l'éthylène urée est utilisée en tant que la au moins une urée cyclique U.

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6. Procédé selon la revendication 1, dans lequel du glyoxal est utilisé en tant qu'aldéhyde multifonctionnel C.
7. Procédé selon la revendication 1, dans lequel de l'acide borique est ajouté au mélange AC ou au mélange (AC)' ou aux deux mélanges AC et (AC)'.
5
8. composition, de revêtement comprenant une résine liante B qui comporte des groupes fonctionnels choisis dans le groupe constitué par les groupes hydroxyle et les groupes acide carboxylique, la résine liante à base de solvant ou d'eau étant choisie dans le groupe constitué par les résines alkyde à fonctionnalité hydroxyl, les résines alkyde à fonctionnalité acide carboxylique, les résines acryliques à fonctionnalité hydroxy, les résines acryliques à fonctionnalité acide carboxylique, les résines de poly(uréthane) à fonctionnalité hydroxy est les résines époxy à fonctionnalité hydroxy, et une composition de réticulation préparée par le procédé de la revendication 1.
10
9. Composition de revêtement comprenant une résine liante B qui comporte des groupes fonctionnel choisis dans le groupe constitué par les groupes hydroxyle et les groupes acide carboxylique, la résine liante à base de solvant ou d'eau étant choisie dans le groupe constitué par les résines alkyde à fonctionnalité hydroxy, les résines alkyde à fonctionnalité acide carboxylique, les résines acryliques à fonctionnalité hydroxy, les résines acryliques à fonctionnalité acide carboxylique, les résines de poly(uréthane) à fonctionnalité hydroxyl et les résines époxy à fonctionnalité hydroxyl, est une composition de réticulation préparée par le procédé de la revendication 2.
15
10. Composition de revêtement selon la revendication 8, dans laquelle la résine liante B est choisie dans le groupe constitué par les résines alkyde à fonctionnalité hydroxy, les résines acryliques à fonctionnalité hydroxy, les résines poly(uréthane) à fonctionnalité hydroxyl et les résines époxy à fonctionnalité hydroxyl, ainsi que leurs mélanges.
20
11. Composition de revêtement selon la revendication 8, dans laquelle la résine liante B est présente sous la forme d'une dispersion laqueuse.
25
12. Procédé d'utilisation de la composition de revêtement de la revendication 8, comprenait les étapes consistant à mélanger une résine liante B qui comporte des groupes fonctionnels choisis dans le groupe constitué par les groupes hydroxyle et les groupes acide carboxylique, avec une composition de réticulation préparée par le procédé de la revendication 1, y ajouter un catalyser choisi dans le groupe constitué par les acides sulfoniques organiques, les acides phosphoniques organiques et les acides de Lewis, appliquer le mélange ainsi préparé sur un substrat par pulvérisation, application au pinceau, immersion ou avec une racle, et facultativement, chauffer pour accélérer la réaction de réticulation.
30
13. Procédé selon la revendication 12, dans lequel la composition de revêtement et le catalyseur sont appliqués à un substrat choisi dans le groupe constitué par le papier, le carton, les textiles, le cuir, le bois, les matières plastiques et les létaux.
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REFERENCES CITED IN THE DESCRIPTION

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